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A

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“DRIP KIT - MORE CROP, PER DROP”

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PREFACE

Micro irrigation system has been reported with frequent failures among small farmers in the dry zone. It has become necessary to promote globally proven technology in our country in order to save water and save nation. Therefore a preliminary study was conducted to evaluate the applicability of a simplified drip system that operates under static pressure (Drip Kit) as an alternative to standard drip systems to small farm holdings, in the range of ¼ to ½ acre.

The study was done at the Regional Agricultural Research and Development Centre (RARDC) in the Kilinochchi District. The trial was conducted in an area of 1/8thof an acre. The banana variety used was tissue culture propagated dwarf cavendish, cultivar *Musa acuminata*. Plants were spaced 2.5 m between rows and 2 m within rows. The Drip Kit used in the study consisted of (a) a headworks system comprising a 4 m high water tower, a 1000 L plastic water tank, a 1 ½" screen filter, water supply and water delivery pipes and associated control devices; and (b) a field system comprising main and sub-main lines, 16 mm laterals, and 2 online drippers per plant, each dripper having 4L//h discharge rate. The plants were irrigated twice a day, with a combined duration of irrigation of 60 minutes per day during the early stages and gradually increasing the time of irrigation with the development stages of growth development with a maximum duration of irrigation of 180 minutes per day during fruit setting and fruit maturity. The total quantity of water applied from planting to harvest to the entire population of 96 plants amounted to 254,208 liters. Total banana yield was 1079.35 kg. Yield, expressed in standard units, was 8.6 tons/acre or 21.7 tons/ha.

The field trial showed that the design of the Drip Kit system was sound. The water tower constructed using two scaffolding unit was stable and served the purpose. The water tank, placed at the top of the water tower at a height of 4 m, provided adequate pressure to operate the drippers. Water saving and water efficiency under the Drip Kit system was much greater compared to potential water use and water productivity of a hypothetical traditional basin irrigation system. Water productivity under the Drip Kit was 4.2 $kg/m^{3,}$ compared to water productivity of 0.5 kg/m^3 under the hypothetical basin irrigation system. The study shows that, a minimum size of land for economically viable banana production, under the Drip Kit system, would be ¼ acre and the optimum size would be ¾ of acre.

Further work is needed to incorporate fertigation facility into the Drip Kit. Other improvements, such as a better design of the water tower, selection of more efficient filtration units and improved drippers (such as pressure compensating drippers) would make the Drip Kit more efficient than the one used in the present trial. It is also recommended that replicated and statistically designed field trials on Drip Kit irrigation are conducted to obtain more reliable results and conclusively assess the potential of the Drip Kit system in banana cultivation by small holding farmers.

As such, Micro irrigation system with feasible Drip-Kit has proved its efficiency in banana cultivation in the dry zone of srilanka.

-Authors

INTRODUCTION

Average annual rainfall in the Dry Zone of Sri Lanka is generally between 1,200 to 1,900 mm with a distinct dry season from May to September. The entire area of the Northern, Eastern and North Central provinces and significant parts of the North Western, Uva and Southern provinces fall under the Dry Zone weather pattern. While critical climatic factors such as temperature, sunshine and relative humidity favour crop growth in the Dry Zone, water shortage remains the limiting factor (Wickramagamage, 2010). The problem of water shortage is further exacerbated by the impact of climate change, which brings decreased and unpredictable rainfall and prolonged droughts and floods (World Bank 2018). Many farming areas in the Dry Zone, particularly the Northern Province, have recently experienced unprecedented drought. Irrigation is, thus, critical for sustainable agriculture in the Dry Zone.

The irrigation practice in Sri Lanka is predominantly surface irrigation, which wastes water and results in a meager 40% efficiency. This means, 60% of water diverted from surface water sources or pumped from wells is wasted. Surface irrigation is also energy intensive, laborious, prone to excessive weed growth and costly. In this context, drip irrigation becomes the best alternative to the traditional surface irrigation method (Kandiah 2016). In drip irrigation, water is applied precisely to the crop very near to its root system, minimizing any wastage. Each drop of water is used by the plant. The efficiency of water use is around 80 to 90%. Crop yields are doubled, and the quality of the produce is superior to that obtained under surface irrigation (TNAU, 2008). Drip irrigation is considered a climate-smart agricultural practice, the best option to minimize climate change impacts and critical to sustaining groundwater use and conservation

CGIAR (2016). Drip irrigation when practiced with compatible and improved agricultural practices, such as improved tillage and land preparation, planting healthy seedlings raised by techniques such as "tissue culture", improved fertilizer management practices and smart pest and disease control measures, results in high productivity and high profit potential (Kandiah, 2018).

In 2016, ONUR launched a drip irrigation project in three districts, namely, Jaffna, Kilinochchi and Hambantota with the objective of introducing drip irrigation technology to small farmers. Under this project, 300 farmers and 100 agriculture extension officers were trained in drip irrigation technology in three districts, namely, Jaffna, Kilinochchi and Hambantota (ONUR, 2016). Subsequent analysis and feed-back from trained farmers revealed that small farmers are reluctant to adopt the "standard drip irrigation systems". Standard drip irrigation systems are expensive, costing around Rs. 650,000 per acre.

Further these systems are technically complex and small farmers find it difficult to operate and maintain such systems, even after training. In addition, standard drip irrigation systems are not economical in small plots of land; they require farm sizes of more than 2 acres (minimum 1 acre) to be economically viable. However, most smallholder farmers cultivate highland crops in lands less the 1 acre, typically ½ to ¼ acre. An alternative to the standard drip irrigation systems for smallholder farmers is the Drip Kit system.

THE STUDY

A study was initiated to test the applicability of the Drip Kit system, a simplified drip system that operates under static pressure as an alternative to standard drip systems to small farm holdings, in the range of ¼ to ½ acre. Objectives of the study were threefold, namely:

(a) To validate the design and installation of the Drip-Kit system;

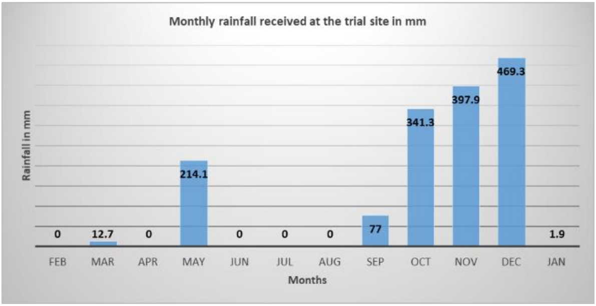
(b) To determine the yield potential and water productivity of banana under a Drip-Kit system; and

(c) To assess the economic feasibility of the system for small holder banana production.

METHODS AND MATERIALS

The study was conducted at the Regional Agricultural Research and Development Centre (RARDC) located along the A9 Road at the Iranamadu Junction, in the Kilinochchi District. The climate was a typical Dry Zone climate with some variation. The total rainfall received at the trial location from February 2018 to January 2019 (period of the study) amounted to 1514.2 mm. The monthly rainfall distribution is shown in Figure 1.

Figure 1. The monthly rainfall received, February 2018 to January 2019 (Data from Arasakesary and Amirthalojanan 2019)



The soil belonged to the Red Yellow Latosol group. It has good texture and good drainage. The chemical properties of the soil are presented in Table 1.

Table 1. The chemical properties of the soil (Amirthalojanan, 2018)

Sample	PH	EC (us/cm)	OM %	K2O (ppm)	P2O5 (ppm)
1	6.23	43.6	1.8	120	4.03
2	6.65	62.1	1.4	142	3.92

Trial was conducted in an area of 1/8thof an acre, which was rectangular in shape and had the dimensions of 20 m width and 25 m length. The banana variety used was tissue culture propagated dwarf cavendish, cultivar *Musa acuminata,* supplied by Hayleys PLC. Plants were spaced 2.5 m between rows and 2 m within rows. There were 8 rows and each row had 12 plants. Altogether, there were 96 plants. Planting was done following standard procedures recommended by the Department of Agriculture. At each planting point, a pit, 45 cm x 45cm x 45 cm was dug and 5 kg of cattle manure was incorporated into the soil. Just before planting, basal dozes of P and K fertilizers, consisting of Triple Super Phosphate (TSP) 100 g/plant and Muriate of Potash (MOP) 50 g/plant, were applied. The first doze of urea was applied 14 days after planting at the rate of 25 g/plant. Subsequent split dozes of fertilizers were applied as per the recommendation of the Department of Agriculture. Fertilizers were applied manually and not through the drip system.

A Drip-Kit system was used to irrigate the plants. Basically, the Drip-Kit consisted of (a) a headworks comprising a water tower, 4 m high, a 1000 L plastic water tank, a 1 ½ " screen filter, water supply and water delivery pipes and associated control devices; and (b) a field system consisting of main and sub-main lines, laterals, online drippers and control valves. The water tower was constructed by stacking two standard scaffolding units one on top of the other. The base scaffolding unit was firmly attached to four anchoring tubes, each anchoring tube buried in a concrete foundation, 60 cm deep and 45 cm x 45 cm in cross section. Figure2 illustrates the features of the water tower of the Drip Kit system.

On top of the water tower, a 1000L plastic water tank was securely placed. The water tank was connected, at the top, to a 1" (PVC) water supply pipe. A water delivery pipe (PVC), 1 ½ "diameter was connected at the bottom of the tank which delivered water to the drippers in the field. The water tank was also attached to a 1" (PVC) drainage pipe at the bottom and a 1" (PVC) overflow pipe at the top. The water flow in the delivery pipe was controlled by a 1 ½ "(PVC) main control valve.

When the main control valve is in open position, water would flow from the water tank to the drip system through a 1 ½ "(PVC) screen filter. The screen filter was an important component of the Drip Kit system, as it filtered the water by removing solid particles in the water and prevented the clogging of the drippers. Figure 3 illustrates the water supply and water delivery arrangements, the position of the screen filter and the main control valve and other associated features. Photograph 1 shows the Drip Kit system used in the study.

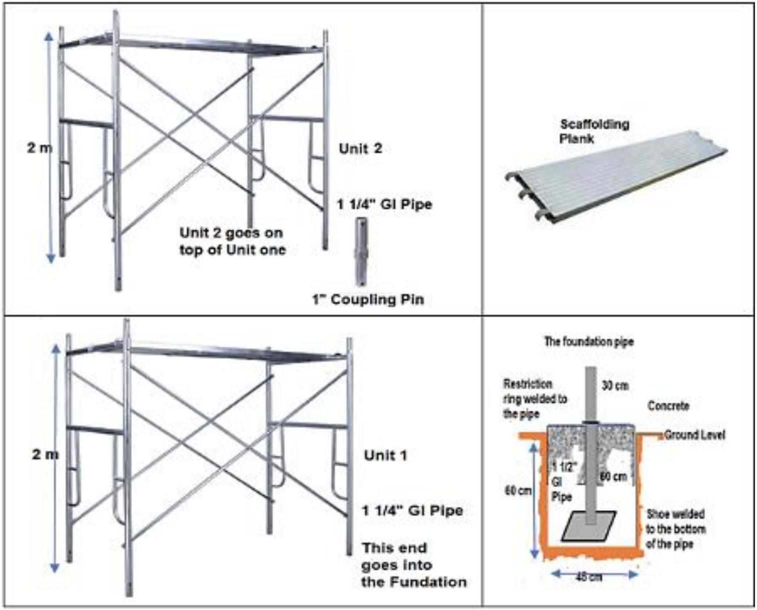


Figure 2. Construction details of the water tower of the Drip Kit system (Sooriasegaram and Kandiah, 2018).

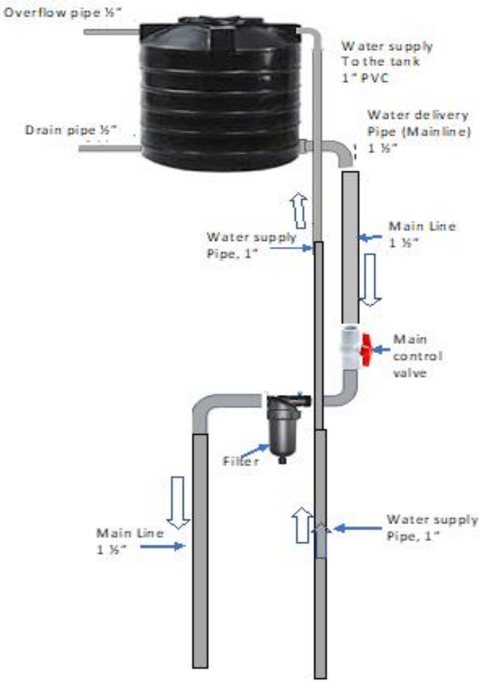


Figure 3. The water supply and delivery systems attached to the water tank (Sooriasegaram and Kandiah, 2018).

Screen Filter		Online drippers	
Screen filter	Inside the online filter	On-line dripper attached to lateral	Online dripper
			

Figure 4. The screen filter and the online drippers

Photograph 1. The Drip Kit used in the study.

On the ground, the main 1 ½" delivery pipeline transitioned into a 1" sub-main pipeline line, which ran along the top of the banana plot. 16 mm (PVC) lateral pipes were connected to the 1"sub-main pipeline coinciding each row of the banana plants. There were 8 rows of lateral pipes, one lateral pipe dedicated to each row of the banana plant. At the base of each banana plant, two online drippers were fixed. Each on-line dripper discharged 4 l/hr. There were altogether 12 laterals. Figure 4 shows the features of a screen filter and online drippers. Figure 5 presents the layout of the trial.

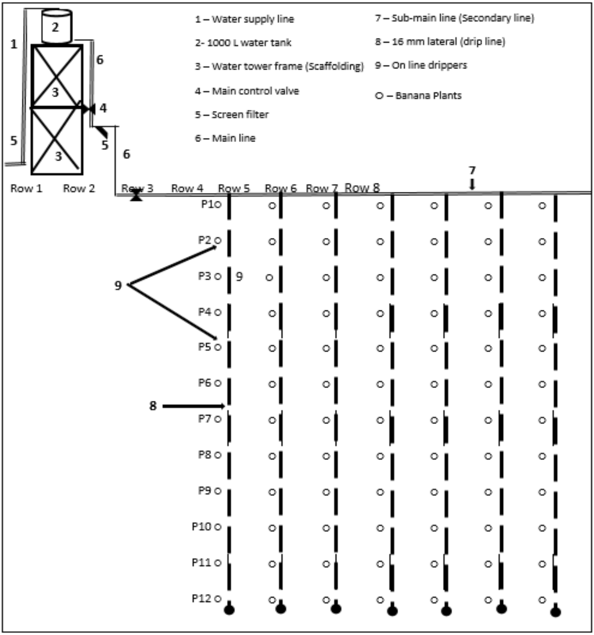


Figure 5. Schematic layout of the trial.

The banana plants were irrigated daily through the Drip-Kit system. Plants were irrigated two times every day. The amount of water applied varied with the stage of growth and the weather condition. The duration of irrigation varied between 30 minutes to 90 minutes. Table 2 presents the watering regime from planting to harvest. Irrigation was stopped during rainy days. Photographs 2, 3, 4 and 5 show the various stages of growth and development of the banana plants.

Seedlings actively growing

Table 2 Watering regime from planting to harvest (Data from Arasakesary and Amirthalojanan 2019).

Days after planting	Stage of growth	Total number of days	Duration of irrigation in the morning (minutes)	Duration of irrigation in the evening (Minutes)	Amount of water applied per day per plant (liters)
1-68 days (26/2 to 24/4)	Seedling & early growth	58	30	30	8
69 - 75 days(25/4 to 2/5)	active growth	7	45	45	12
76 - 99 days (3/5 to 26/5)	Active growth	23	No irrigation (due to rainfall)	No irrigation (due to rainfall)	0
100 - 107 days (27/5 to 3/6)	Active growth	8	30	30	8
108 - 117 days (4/6 to 13/6)	Active growth	10	60	30	12
118 to 135 days (14/6 to 30/6)	Active growth	17	30	60	12
136 to 144 days (1/7to 4 /7)	Active growth	4	No irrigation (due to rainfall)	No irrigation (due to rainfall)	0
145 to 162 days (5/7to 21 /7)	Active growth	17	30	60	12
163 to 182 days (22/7to 8/8)	Active growth	19	90	60	20
183 to 185days (9/8 to 11/8)	Flower initiation	3	No irrigation (due to rainfall)	No irrigation (due to rainfall)	0
186 to 198 days (12/8 to 23/8)	Flowering	12	90	60	20
199 to 301 days (24/9 to 3/1)	Flowering and fruiting	102	No irrigation (due to rainfall)	No irrigation (due to rainfall)	0
302 to 310 days (4/1 to 11/1)	Fruit maturity	8	90	90	24
311 to 312 days (12/1 to 13/1)	Fruit maturity	2	No irrigation (due to rainfall)	No irrigation (due to rainfall)	0
313 to 332 days (14/1 to 2/2)	Fruit maturity	19	90	90	24
333 to 341 days (3/2 to 10/2)	Fruit maturity	8	No irrigation (due to rainfall)	No irrigation (due to rainfall)	0
342 to 352 days (11/2 to 20/2)	Fruit maturity	10	90	90	24

Photographs 2, 3, 4 and 5. Bananas at various stages of growth, development and fruiting


Photo 2: Tissue culture banana seedlings


Photo 3: Seedlings actively growing


Photo 4: Mature banana during flower initiation


Photo 5: Banana with fruits

RESULTS AND DISCUSSION

(a) The design and construction of the Drip Kit system

The design and construction of the water tower, the pipelines, and field drip system have met the engineering standards. The construction of the water tower utilizing two standard construction scaffolding units proved to be efficient and economical. The concrete foundation of the anchoring tubes provided adequate stability to the water tower. The fact that the water tower could be constructed in two days was a positive aspect of the design and construction.

The use of a readily available plastic water tank of 1000 L capacity was another added advantage of the design. 1000 L capacity plastic tanks, manufactured by companies such as S-Lon PE (by PE Plus (Pvt) Ltd); The Plastic shells Tank (Arpico-Richard Pieris Group); Anton Max Double Layer Water Tank (Anton by St.Anthony's Industries Group) and a few other others, are available in hardware stores all over in Sri Lanka at an affordable cost. The cost of materials for the construction of the water tower, including the scaffolding units, 1000 L plastic water tank, and foundation for anchoring the water tower, was around Sri Lanka Rupees 45,000. It should be noted that a team of an experienced mason and a plumber is required to construct water tower, secure the water tank atop of the water tower and make appropriate pipe connections. In addition, a minimum of two labourers are required to dig the foundation and assist the mason and the plumber.

(b) The design and installation of the screen filter, water delivery pipes and the field system

The water delivery pipes conveyed water from the water tank to the drippers (emitters). Water flow was controlled by a single 1 ½ "ball valve fitted to the main pipeline which ran down, perpendicularly, from the water tank. When the ball valve was in open position water flowed down to the secondary pipeline through a screen filter. The screen filter was fitted to the delivery pipe in such a way to minimize turbulent flow and for this purpose, it was fixed to the horizontal portion of the pipeline. For this purpose, two 90^{o}bends were utilized in the design, as illustrated in Figure 6.

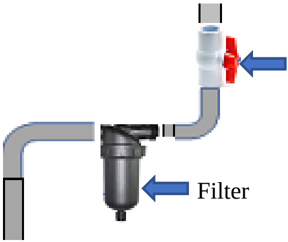


Figure 6. Details of fitting the screen filter on to the delivery pipe.

The 1 ½" main water delivery pipe, upon reaching the ground was directed towards the banana plot and was transitioned into a 1" secondary pipeline by means of a reducer. At the point of transition, a 1" ball valve was fixed to control the flow into the secondary pipeline. The secondary pipeline ran along the top of the banana plot.

At the end of the secondary pipeline, a 1" ball valve was fixed. This valve acted as a "flushing valve, which would be opened periodically to flush out sediments and soil particles that accumulate in the pipes.

(c) The field Design

The 16 mm lateral pipes were connected to the secondary pipeline by means of barbed connectors and grommets. These were very critical connections. It was important to ensure that water did not leak at these connections. At the very end, the lateral tubes were tightly closed to ensure that water did not leak when the system was under operation. This was achieved by completely bending (180^{o}) the tubes and fastening them with plastic twine.

Along each lateral, two drippers were fixed close to the base of each banana plant. One lateral irrigated 12 plants and thus there were 24 drippers (12 pairs) in each lateral. Each dripper had a manufacturer's discharge rate of 4 L/h.

(d) Water Application

Irrigation was done twice daily, except for rainy days. Water was applied in the morning, (around 8 to 10 am) and in the afternoon (3 to 5 pm). The duration of irrigation varied with the growth and development stages of the plants as shown in Figure 7.

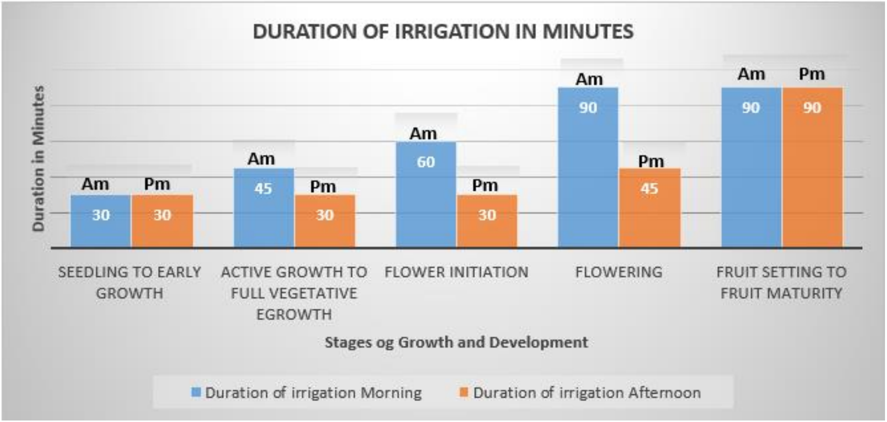


Figure 7. Variation of duration of irrigation with the stages of growth and development phases.

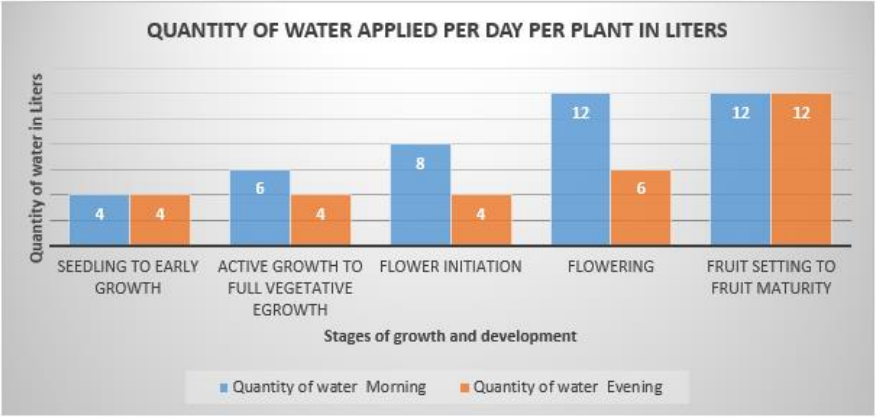


Figure 8. Variation of quantity of water applied with the stages of growth and development phases.

Figures 7 and 8 illustrate a progressive increase in irrigation duration and quantity of water applied as the plant grows, flowers and produces fruit. Combined application of water, morning and evening applications, increased in the following manner:

8 liters/day/plant during the seedling to early growth stage;
10 liters/day/plant during active growth and full vegetative growth stage;
12 liters/ day/plant during the flower initiation stage;
18 liters/ day/plant during flowering stage; and
24 liters per day during the fruit growth and maturity stage.

There was quite a bit of variability among the banana population within the plot in terms of growth, flowering and fruiting. This could have been due to variations in water discharge by drippers from the top to the bottom of a long lateral and between laterals. It could also be partially due to variation in soil properties within the plot.

The variation in growth and development was reflected in the flowering pattern of the plants. Flowering spanned over a two month period, beginning on 19 August 2019 to 10 October 2019, despite the fact that all seedlings were planted on the same day. Figure 9 illustrates the distribution dates of flowing among the banana population.

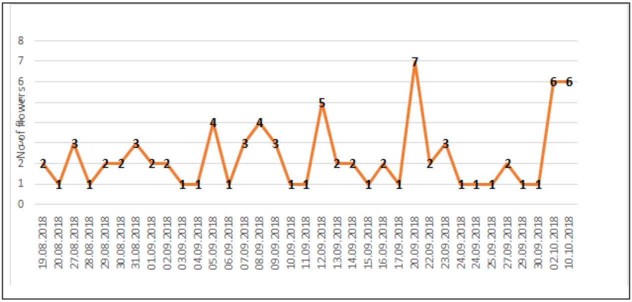


Figure 9. Distribution of flowing among the banana population (Amirthalojanan, 2018).

15 plants located at the end of laterals due to receiving less water, flowered at long after 10.10.2018. Therefore they were not included in Figure 9. The total quantity of water applied from planting to harvest to the entire population of 96 plants, -28 February 2018 to 20 February 2019 - amounted to 254,208 liters. It should be noted that no irrigation was done during the period -24 September 2018 to 3 January 2019 - as there was plenty of rainfall during these months. The total rainfall recorded during this period was 1223.8 mm. The distribution of water from day 1 (planting) to 352 days (harvest) is shown in Figure 10.

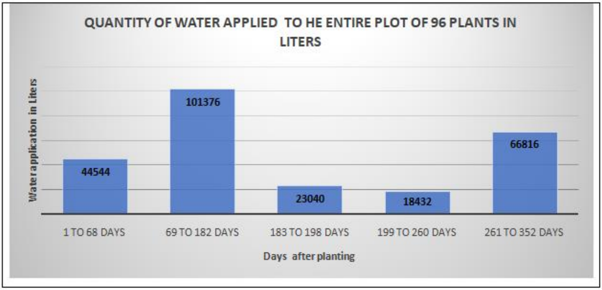


Figure 10. Quantity of water applied

CROP YIELD

Harvesting began on 27.12.2018. Out of a population of 96 plants, harvesting was made from 63 plants (as of 20. 02.2019). Table 3 shows the yield of banana. Total banana yield was 1079.35 kg. Average yield per banana plant was 17.1 kg. Yield expressed in terms of standard units comes to 8.6 tons/acre or 21.7 tons/ha. This yield is impressive. National average of banana yield is around 15 tons/ acre and average banana yield in the Northern Province is reported to be around 20 tons/acre. It should be noted the cultivar of banana planted was tissue culture propagated dwarf cavendish which is a medium yielding cultivar. However, it is a short duration variety, producing fruits in about 9 to 10 months.

Bunch of Cavendish Banana

WATER PRODUCTIVITY

Water productivity, with respect to crop production, is referred to as crop water productivity (CWP) and is defined as the amount of crop produced per volume of water used. The unit of CWP is kg/m^3.

In this field trial, a total of 254,208 liters or 254.2 $m^3$of water were applied. The total crop production was 1079.35 kg of fresh banana. Water productivity of banana under the Drip Kit irrigation, calculated from the results of this preliminary study, works out to be 4.2 kg/m^3.

Observation of water productivity

Table 3. Yield of banana in kg (Data from Arasakesary and Amirthalojanan, 2019)

Date of harvest	Line and plant no.	Total Weight in kg
27.12.2018	Line-03-02	16.5
	Line-02-04	19.5
	Line-02-08	18.5
	Line-01-06	16.5
	Line- 02-09	20.5
	Line-03-03	17.5
	Line -01-03	16.5
	Line-02-10	17.05
	Line-01-06	16.3
	Line-02-01	17
	Line-04-03	17
	Line-04-02	18.5
	Line-04-11	17.5
	Line-04-04	18.5
	Line-01-11	17
	Line-05-01	17.5
Total Weight		281.85

Table 3 (a) Date of harvest, plant number and yield

Table 3. Yield of banana in kg (Data from Arasakesary and Amirthalojanan, 2019), **cont'd.**

Date of harvest	Line and plant no.	Total Weight in kg
27.12.2018	Line-03-09	18
	Line-02-02	15
	Line-12-09	21
	Line-04-10	18
	Line-01-07	17.5
	Line-12-12	17
	Line-01-05	15
	Line-01-07	17
	Line-07-08	16.5
	Line-02-05	16.5
	Line-05-06	17.5
	Line-05-07	15.5
	Line-06-10	15
	Line-06-01	17.5
	Line-04-04	18.5
	Line-03-10	15.5
Total Weight		271

Table 3 (b) Date of harvest, plant number and yield

Table 3. Yield of banana in kg (Data from Arasakesary and Amirthalojanan, 2019), **cont'd.**

Date of harvest	Line and plant no.	Total Weight in kg
	Line-03-08	15
01.01.2019	Line-05-10	16
	Line-04-08	16.5
	Line-07-11	15.5
	Line-03-01	15
	Line-12-05	17
	Line-03-12	18
	Line-06-07	17
	Line-12-06	17.5
	Line-01-09	16
02.01.2019	Line-06-11	18.5
	Line-01-02	16.5
04.01.2019	Line-08-08	18
	Line-07-09	17.5
	Line-06-03	16
	Line-02-11	16.5
Total Weight		266.5

Table 3 (c) Date of harvest, plant number and yield

Table 3. Yield of banana in kg (Data from Arasakesary and Amirthalojanan, 2019), **cont'd.**

Date of harvest	Line and plant no.	Total Weight in kg
	Line-05-02	19.5
07.01.2019	Line-02-07	20
	Line-03-07	17.5
	Line-05-09	16.5
	Line-03-05	17.5
	Line-07-02	15.5
	Line07-11	16.5
	Line-07-05	16
	Line-05-12	18
11.01.2019	Line-08-07	18.5
22.01.2019	Line-05-08	15.5
24.01.2019	Line-06-04	16.5
	Line-08-04	18
13.02.2019	Line-02-06	17
15.02.2019	Line-03-11	17.5
Total Weight		260

Table 3 (d) Date of harvest, plant number and yield

Total banana yield in Kg Table (a)	Total banana yield in Kg Table (b)	Total banana yield in Kg able (c)	Total banana yield in Kg Table (d)	Grand total of banana yield in Kg
281.85	271	266.5	260	1079.35

It is assumed that if the plots were irrigated by the traditional surface irrigation of basin system, irrigation would have been done every 4 days during the non-rainy days. During each application, a minimum of 4 mm water would have been applied. On this basis, a total amount of 1984 $m^3$of water would have been applied, as shown in Table 3. Water productivity under this hypothetical basin irrigation system, assuming the same yield, works out to 0.5 kg/m^3.

Table 3. Hypothetical calculation of water use under a basin irrigation system.

Month	Rain mm	No of irrigation per month	Amount per irrigation mm	Total amount of irrigation per month mm	Volume in m^3
Feb	0	2	4	8	64
Mar	12.7	6	4	24	192
Apr	0	8	4	32	256
May	21.4	5	4	20	160
June	0	8	4	32	256
Jul	0	8	4	32	256
Aug	0	8	4	32	256
Sep	77	4	4	16	128
Oct	341.3	0	4	0	0
Nov	397.9	0	4	0	0
Dec	469.3	0	4	0	0
Jan	1.9	8	4	32	256
Feb	21.7	5	4	20	160
Total amount of water					1984

ECONOMIC ANALYSIS

The cost of installing the Drip Kit system (material, installation and labour costs) for the 1/8th ha of the banana plot worked out to Sri Lankan Rs. 80,000, as shown in Table 4.

Table 4. The cost of installing the Drip Kit system

Component	Cost, Srl. Rs.
Material cost of head works including scaffolding, 1000 L water tanks and foundation.	45,000
Material cost of the field system including drippers, pipelines, laterals, screen filter, valves and connectors.	20,000
Cost of Installation including the wages to the drip technician, mason and plumber and laborers and transporting of material to the site.	15,000
Total cost	80,000

Cost of planting material, fertilizers, agrochemicals, and operation and maintenance of the drip system (including technicians' salaries and labour cost) is estimated as Rs. 50,000.

The total cost of installation and production amount to 130,000.00. Total banana yield was 1079.35 kg. At a market price of Rs.60.00 per kg, the total income from the plot was 64,761/-. This variety (cavendish) if exported, will fetch up to Rs.100/- per Kg due to its better keeping quality and better appear in oversea market. If export market facilities are arranged profitability can be substantially increased.

The trial conducted was purely for experimental purpose and not for commercial production. Therefore, strictly speaking, a cost-benefit analysis of the trial data for commercial -scale banana production is not applicable. However, if we apply the cost-benefit analysis to a commercial production system, we could come to the following conclusion:

(a) Producing banana under the Drip Kit system in a plot of 1/8th of an acre will take about 2 years of production to recover capital cost. In year 2 some profit could be expected.

(b) On the other hand, if banana is cultivated under the same Drip Kit system on a ¼ acre plot, the capital cost would be fully recovered in the 1st year itself. Year 2 will lead to good profit making.

(c) If the area of planting is extended to ¾ of an acre, which the 1000 L tank system can support, the capital cost would be fully recovered in the first year of production and some profit could be expected in the first year itself.

In order to make farmers adopt this high water productivity technology affordably government subsidies the cost of installation of the drip kit (approximately Rs.80, 000.00).

CONCLUSION

The study reported in this paper was a preliminary trial. It was not a replicated experiment and should be considered an observational trial. Nevertheless, it has provided a number of very useful information.

The field trial showed that the design of the Drip Kit system is sound. The water tower constructed using two scaffolding unit was stable and served the purpose. The water tank, placed at the top of the water tower at a height of 4 m, provided adequate pressure to operate the drippers. The water tower gave a theoretical pressure of 0.4 bar at the ground level. However, there would be loss of pressure head as water flows through the pipes, screen filter, bends and connections. The average pressure needed to operate the drippers is 0.3 bar. It appears that the pressure head loss in the system was less than 0.1 bar, and the system provided the minimum pressure necessary for the functioning of the drippers.

The Drip Kit is very simple in design, the materials needed are readily available, the system is easy to install and the whole system could be installed within two days. Cost wise, the Drip Kit is relatively cheap and costs around Srl Rs, 80,000 for a 1/8th acre land and Srl Rs. 120,000 for a ¼ acre land. The system can be easily operated and maintained by small holding farmers. The Drip Kit system tested in the trial was a simple version. It did not have provision to supply fertilizers with the irrigation water (fertigation) which is typical in standard drip systems.

Water saving and water productivity under the Drip Kit system was enormous, compared a hypothetical traditional basin irrigation system. Water productivity under the Drip Kit was 4.2 kg/m^{3,} compared to water productivity of 0.5 kg/m^3 under the hypothetical basin irrigation system. In terms of economics, a minimum size of land to grow banana for commercial purposes, under the Drip Kit system, would be ½ acre and the optimum size would be ¾ of acre.

Further work is needed to incorporate fertigation facility into the Drip Kit. Other improvements in the design of the water tower, and selection of a more efficient filtration units and improved drippers (such as pressure compensating drippers) will make the Drip Kit more efficient than the one used in the present trial.

It is also recommended that replicated and statistically designed field trials on Drip Kit irrigation are conducted to obtain more reliable results and more accurately assess the potential of the Drip Kit system for banana cultivation by small holding farmers.

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NOTES

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